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Training Modeling and Simulation
Master Plan

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Technology Division
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Table of Contents

Purpose

This plan is a supporting document to Marine Corps strategic planning guidance and those documents guiding force capability development. It serves as the initial road map for developing training technology requirements and fully implementing Modeling and Simulation (M&S) in support of the MAGTF Capability List (MCL) and MAGTF Requirement List (MRL). By describing objectives and clarifying responsibilities, this plan outlines an approach by which the operating forces and supporting establishment will, over the next ten years, fully integrate with Marine Corps and Joint capabilities development processes as a means of achieving the desired end state.

This plan serves both the Marine Corps and industry as a source document for current and objective capabilities for virtual and constructive simulation in support of the Marine Corps. Supporting plans are intended to be developed to include more detailed development and implementation of M&S in support of all MAGTF training.

Background

As stated in Marine Corps Strategy 21, "our goal is to make America's Marines comprise the premier expeditionary 'Total Force in Readiness.'" Specific aims supporting this goal include "expand[ing] our participation in science and technology developments to enhance the capabilities of the Total Force;" and "creat[ing] a distributed planning, training, and rehearsal capability for the MAGTF at the tactical and operational levels of war to include enhanced amphibious capability." Technological advances, the availability and affordability of training technology, and alignment and integration of Joint and Marine Corps capabilities development processes have out-paced the usefulness of existing M&S master plans. A renewed effort is necessary to meet critical training requirements, with an emphasis on training for the GCE.

The need to develop and maintain readiness across the spectrum of Marine Corps missions, in a resource constrained environment, places a premium on using the most effective and efficient means available for mission essential training. Training simulation technology (which includes all training devices, training simulation and training technology for Marine Corps systems) and a Live Virtual Constructive – Training Environment (LVC-TE) provides a critical component of the means by which objective training efficiencies and economies may be achieved in training transformation.

LVC-TE is a synthetic battlefield that combines live, virtual, and constructive training tools through interoperability of the systems. Live training is that which is conducted in a physical environment. It occurs on firing ranges and in the limited maneuver areas available on some installations. Virtual simulation training provides pilots, drivers, crews, leaders and units with realistic training experiences using sophisticated simulators and simulations virtual windows into the battlefield. Constructive simulation training is the use of computer simulations with 2D representations of the battlefield and representative behavior of models either autonomously or semi-autonomously with some human in the loop control of models. The LVC-TE combines any of these three approaches and C4 systems to create a common battlefield, on which live units can be represented along with virtual and constructive. These units can interact with one another and conduct a coordinated fight as though they were physically together on the same ground.

The Technology Division (TechDiv) of the Marine Corps Training and Education Command (TECOM) is the resource sponsor and training capabilities developer of ground-based training simulation technology. Ground-based training for this document includes training in support of ground combat units, logistic units and ground and air command and control. The Program Manager for Training Systems (PM TRASYS) is the Marine Corps Systems Command's independent PM assigned responsibility to provide services and products to support the development and life cycle support of USMC training and training systems. Training technology is produced through collaboration between the operating forces, TechDiv, PM TRASYS, the Marine Corps Combat Development Command (MCCDC), Marine Corps Warfighting Laboratory (MCWL) and Science and Technology partners at the Office of Naval Research (ONR) and the Defense Advanced Research Projects Agency (DARPA). Such collaboration supports the

development of enabling capabilities for Expeditionary Maneuver Warfare (EMW), and creates alignment with overarching Department of Defense (DoD) Training Transformation (T2) initiatives and the Marine Corps Strategy for Science and Technology.

Mission

Invigorate and sustain the development and fielding of modeling and simulation throughout the operating forces and supporting establishment to maximize the use of training simulation technologies across all levels of the MAGTF training continuum, and exploit available technology to increase training effectiveness while more efficiently utilizing scarce resources.

Objective End State

The objective end state is an M&S capability that is integral to training programs by addressing training and capability shortfalls. This capability will support efficiency to prepare and sustain MAGTFs that are enabled by small-unit leaders operating in a distributed environment across the spectrum of conflict in support of joint force requirements.

The objective is a robust, agile, and scalable M&S infrastructure and family of systems that increases efficiency by providing increase opportunities to make decisions from the procedural level to the MAGTF level that satisfies conditions and standards associated with training and readiness (T&R) standards. This end state will provide capabilities for progressive training, mission planning, and mission rehearsal; will be accessible by both the active and reserve components; will be adaptable for virtual representation of any location and environment; and will be deployable and functional while in-garrison, afloat or ashore. Specific attributes that will define and sustain this capability include:

- Training transformation policy, organization and processes that reinforce existing Marine Corps and Joint capabilities development and integration activities in support of training, mission planning, Course of Action wargaming, and mission rehearsal.

- M&S that is institutionalized and acculturated throughout the Total Force, with sufficient availability of training simulation technology, resources, infrastructure, and technical support. Capability will be sufficient in both the operating forces and at formal training centers and schools to satisfy individual and collective training requirements while in-garrison, afloat or ashore; and will be available through embedded, simulated or stimulated capability in new equipment and systems that support operator and maintainer system training. Such a capability should also interface with training management systems in order to document training and report corresponding changes in readiness.

- Inter- and intra-component training (for the Marine Corps down to the Company level) that is enabled by virtual and constructive simulations with editable scenarios, access to terrain libraries, real world imagery and video and interoperable with or embedded within operational C2, weapons systems and sensors. Systems will be capable of interoperating via a fully networked LVC-TE that is Joint National Training Capability (JNTC) compliant.

- Simulation systems will utilize tailorable artificial intelligence and intelligent agents that exercise levels of decision making through application of tactics, techniques and procedures; rules of engagement and the Law of Armed Conflict. Systems will also have a robust capability to model and simulate kinetic and non-kinetic military operations, to include nation-building, force protection, humanitarian assistance and disaster relief that incorporate political, economic, cultural and informational lines of operation.

Assumptions

- Training simulation technologies must satisfy individual and collective training requirements as defined in T&R Manuals and in support of the Marine Corps Task List (MCTL).

- Marine Corps Systems Command will continue to manage and develop all current approved M&S systems in the field, in development, and emerging technologies in research and development.

- Initiatives proposed will compete for funding in POM-2010.

- TECOM Campaign Plan 02-05 (United States Marine Corps Training and Education Transformation) Phase I – FY 2005-2007 tasks will be completed.

Current State

A range of training tools and simulation technologies is available to train Marines at all echelons of command. However, existing M&S utilization is ad hoc and problematic as the operating forces and training commands struggle with operational commitments and other training requirements. These challenges have hindered the opportunity and ability to fully incorporate M&S within the mainstream of unit level training programs and formal training institutions. The acceptance and use of existing training simulation technologies is inconsistent across the Marine Corps and numerous shortcomings exist with the manner in which the Marine Corps has sought to fully implement M&S as a key component of comprehensive training programs.

Existing training simulation technologies have not always adequately met needs of the operating forces and supporting establishments in an organized preplanned manner. The net result is the absence of an institutionalized technology supported training capability to meet the challenges associated with developing a comprehensive simulation environment that meets training needs at all levels of unit training. Additionally, there is only a sporadic understanding of M&S capabilities and how to effectively incorporate existing and anticipated technologies as part of a comprehensive training program.

Infrastructure requirements and resource demands have resulted in selected fielding of M&S systems to limited fixed locations which have constrained availability, adaptability and responsiveness to the operating forces. At all levels within the Marine Expeditionary Force (MEF)s, and within the formal training centers and schools, insufficient M&S system capacity and resources exist to adequately support the increasing demand for basic procedural training needs. Simulation Centers have a distributed simulation capability to support Marine Corps staff level training with incorporated C4 training.

In general, current capabilities associated with M&S in support of ground and air command and control training exhibit the following characteristics:

- Small unit virtual training (Company and below) focused on tactics, techniques and procedures.

- Staff training (Battalion to MEF level) that simulates kinetic military operations and necessitates scripted Master Scenario Events Lists injects to train to non-kinetic operations.

- Functional task trainers and simulators with limited fielding or central location at Marine Air Ground Task Force Training Command (MAGTFTC).

- Increased demand for simulation supported tactical training has created a greater demand on simulation center resources.

- Distributed Joint and combined training opportunities involving different simulations and simulation versions is constrained by resources and technology.

Emerging Capabilities

A number of training devices and systems are in development or being fielded to facilitate training in a seamless, transparent, live, LVC-TE. These devices and systems incorporate operational C2 and combat systems to improve training and increase readiness.   These tools range from minor training devices, task

trainers and simulators, tactical decision simulations, entity-level constructive warfare simulations, and upgrades to existing training systems or network infrastructure.

The following additional M&S capabilities are anticipated within **two** years:

- Combined Arms Staff Trainer (CAST) upgrade through fielding of the Combined Arms C2 Training Upgrade System (CACCTUS).

- Persistent access to the Joint Training and Experimentation Network (JTEN) Simulation Centers.

- Fielding of the Deployable Virtual Training Environment (DVTE) to the regimental level.

- Acquisition of Virtual Battlefield Simulation 2 (VBS2) software.

- Federation of MAGTF Tactical Warfare Simulation (MTWS) and Joint Conflict and Tactical Simulation (JCATS).

A review and validation of requirements is necessary to ensure that these systems are supported to the appropriate level and are fielded at the appropriate timeframe to satisfy near and mid-term requirements and establish the objective capability.

Strategy

This plan outlines a "building block" approach to incorporating training simulation systems across the Marine Corps ground-training continuum and achieving the end-state within ten years. As depicted in Figure 1 below, this strategy incorporates three distinct planning horizons; Near-Term (2007-2009), Mid-Term (2010-2014), and Far-Term (2015-2017). These horizons are broken down later and visualized in a Program of Actions & Milestones (POA&M) in Appendix A and a Roadmap in Appendix B.

This plan is not intended to be prescriptive in detail. It is intended to set the conditions by which subsequent detailed training planning, requirements generation linked to capability gaps, capabilities development, research and development, system integration, acquisition and successful fielding can be accomplished in an adaptive and iterative manner using spiral development and best practices. Spiral development supports fielding a capability to the fleet faster by incorporating new technologies into systems, rather than delivering solutions using only those technologies that existed when the system was initially designed.

Such a strategy is enabled by sufficient resources to execute all associated implementation actions. The strategy's policy and processes will provide for; appropriate management responsibility, account for the needs of the operating forces and provide mechanisms for continuous re-evaluation of requirements. This strategy provides the requisite depth and breadth to accomplish all tasks and the agility required to manage fluid environmental factors, changing priorities and availability of resources.

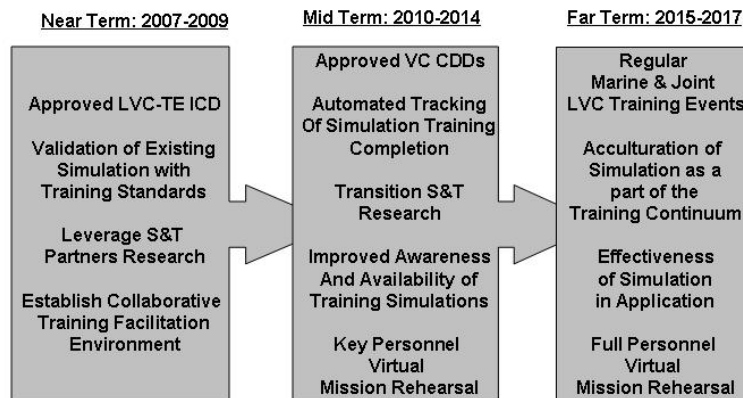| Near Term: 2007-2009	Mid Term: 2010-2014	Far Term: 2015-2017
Approved LVC-TE ICD	Approved VC CDDs	Regular Marine & Joint LVC Training Events
Validation of Existing Simulation with Training Standards	Automated Tracking Of Simulation Training Completion	Acculturation of Simulation as a part of the Training Continuum
Leverage S&T Partners Research	Transition S&T Research	Effectiveness of Simulation in Application
Establish Collaborative Training Facilitation Environment	Improved Awareness And Availability of Training Simulations	Full Personnel Virtual Mission Rehearsal
	Key Personnel Virtual Mission Rehearsal	

Figure 1. Master Plan Concept of Execution

Near-Term. 2007 to 2009

Objectives:

- Fully integrate training system technologies capabilities development and advocacy processes with linkage to the MCL and MRL.

- Identify training standards and requirements most appropriately satisfied by simulation.

- Identify and re-validate baseline of existing and developmental training simulation technologies.

- Identify Inter- and Intra-MEF networking requirements to facilitate distributed training.

- Identify training technology support opportunities to Regimental Combat Team Pre-deployment Training Program (RCT PTP)

- Identify emerging opportunities to leverage other service efforts.

- Identify staffing requirements for TechDiv, MEF, MAGTF Staff Training Program (MSTP) M&S Branch, MAGTFTC and Simulation Centers.

- Field and support near-term critical requirements for operating forces and schoolhouses.

- Improve or divest existing M&S capabilities that do not satisfy the objective requirement.

- Prioritize C2 systems (e.g. C2PC, AFATDS, IOW, JADOCS, TBMCS) for integration with existing training simulation technologies.

- Develop implementation plans for M&S ground training systems technology refresh and fielding.

- Complete the USMC LVC-TE Initial Capability Document

Tasks:

Task	Lead	Support	Milestone
Publish/Revise policy guidance for management of M&S	MCCDC	TECOM	1st Qtr FY07
Establish M&S Working Integrated Product Team (WIPT)	TECOM	MEFs; MCSC	1st Qtr FY07
Implement EFDS functions for M&S Capabilities Development	TECOM	TechDiv	4th Qtr FY07
Review training standards of selected OccFlds to ID near-term training systems technology requirements	TECOM	Trng Com; MEFs	2d Qtr FY07
Validate requirements for current training simulation technology and identify technology gaps	TECOM	TechDiv	3d Qtr FY07
Identify emerging training simulation technology and opportunities (Emerging; R&D; Other Components)	TECOM	MCSC; MCWL	3d Qtr FY07
Submit Program Change Proposals for current programs	TECOM	MCCDC; MCSC	4th Qtr FY07
Develop detailed supporting implementation plans	TECOM	M&S WIPT; MCSC	1st Qtr FY08
Develop Staffing plan for TechDiv, MSTP/BSTF Simulation Centers and MCCDC	TECOM	MCCDC	1st Qtr FY08
Examine Training Technology Support to Regimental Combat Team Pre-deployment Training Program	TECOM	TECOM	2st Qtr FY08
Sustain present investments	TECOM	MCSC	Ea FY
Execute training simulation technology Info campaign	TECOM	MEFs	1st Qtr FY08
Submit POM-10 initiatives	TECOM	M&S WIPT; MCSC	3d Qtr FY08
Acquire and field critical training simulation technologies to MEFs, BSTFs and selected schoolhouses	MCSC	TECOM	4th Qtr FY09
Develop divestiture plan for legacy systems	MCSC	TECOM	4th Qtr FY09

Mid-Term. 2010 to 2014

Objectives:

- Achieve manning goals.

- Review of all training requirements and standards for ground occupational fields with consideration for application of training simulation technology.

- Sustain and expand capabilities and requirements for acquisition of training simulation technologies

- Improve interconnectivity between simulation centers, bases, and stations for conduct of distributive virtual and constructive training.

- Achieve full operating capability for a live, virtual and constructive training environment that is compliant with JNTC requirements.

- Institutionalize development of combat and combat support systems (C4I, weapons and sensors) with integral training simulation capabilities and interoperability with LVC-TE.

- Integrate emerging training simulation technologies with advanced warfighting experiments.

- Educate all commanders, trainers, and unit training managers in the application of existing training simulation technologies.

Tasks:

Task	Lead	Support	Milestones
Force Structure Review	MCCDC	TECOM	1st Qtr FY10
Provide appropriate manning to TechDiv; MEF and MAGTFTC Sim Centers;	MCCDC	HQMC MM; TECOM	1st Qtr FY10
Review individual/collective ground training standards to be satisfied by training systems technologies	TECOM	MEFs; Trng Cmd	4th Qtr FY10
Sustain and expand "Near Term" requirements and capabilities	TECOM	MCCDC	Ea FY
Identify emerging training simulation technology (R&D, New Starts, other service)	TECOM	MCSC	Ea FY
Identify and prioritize developmental systems (C4I, weapons and sensors) for integration with M&S	TECOM	MCSC	Ea FY
Prioritize and resource ongoing and future initiatives for research, development and acquisition.	TECOM	MCSC	Ea FY
Conduct experimentation for continued application of training simulation technology to emerging concepts	MCWL	TECOM	Ea FY
Update POM, PR, and supplemental appropriations	TECOM	MCCDC; MCSC	4th Qtr Ea FY
Execute a Training simulation technology road show	TECOM	MEFs	Ea FY
Achieve Full LVC-TE/JNTC Capabilities	TECOM	MCSC	POM-12

Far-Term. 2015 to 2017

Objectives:

- Ongoing requirements generation, capabilities development, integration and fielding of training systems and technologies consistent with established Marine Corps and Joint processes.

- Achieve regular Marine training in a LVC-TE combined with larger JNTC exercises.

- Achieve full operational capability for a fully networked M&S capability that interconnects, each of the three MEF Simulation Centers, the MAGTF Training Center, and the MSTP BSTF.

- Embed simulation and simulator capabilities within all fielded operational C2, combat, and combat support systems and sensors capable of integrating with the LVC-TE.

- Fully acculturate the use of M&S throughout all phases of Total Force training and operations.

Tasks:

Task	Lead	Support	Milestones
Monitor execution of supporting plans	TECOM	MCCDC; MCSC	Ea FY
Update POM, PR and supplemental appropriations	TECOM	MCCDC; MCSC	4th Qtr Ea FY
Regular Marine Training in the LVC-TE	TECOM	MCSC	POM-14

Process Toward Objective Endstate

Identifying and Validating Training Technology Requirements

M&S can be a key enabler for training associated with each of the warfighting functions, and existing Marine Corps and Joint processes drive the identification, validation, prioritization, and budgeting for development of desired capabilities. However, current policy and processes do not describe in sufficient detail how M&S is considered or integrated vertically and horizontally throughout these interrelated capabilities development processes. To successfully implement training simulation technologies in support of the MAGTF Capabilities List (MCL) and MAGTF Requirement List (MRL), and to ensure that the interests of all stakeholders are sufficiently represented and considered throughout the process, structures for managing and implementing M&S need to be established.

TechDiv serves as the ground based technology training capabilities developer for the Marine Corps. As the capabilities developer for training, it is responsible for reviewing and integrating all technology based training capabilities for all warfighting integration divisions and programs. Additionally, TechDiv, along with PM TRASYS, assists in developing POM submissions for training systems. A description of the capabilities development process is beyond the scope of this document. However, additional information regarding the capabilities development process can be found in MCO 3500.19A Expeditionary Force Development System (EFDS) and at the TechDiv web site (http://www.tecom.usmc.mil/techdiv/).

To facilitate the effectiveness of the life cycle of M&S systems and to mainstream and codify M&S systems within the training community, an M&S Working Integrated Product Team (WIPT) will be organized. The M&S WIPT will be chaired by TechDiv and comprised of members from each of the MEFs, designated formal schools, MSTP, Marine Forces Reserve and advisory members from the PM TRASYS, the Marine Corps Warfighting Laboratory (MCWL) and the Office of Naval Research (ONR). The M&S WIPT will conduct meetings no less than on a semi-annual basis and develop a formal charter to identify, validate, and prioritize relevant technology needs for further consideration by the advocate boards for decision and assignment to the training technology developer. Furthermore, the M&S WIPT will provide the forum for sharing information across the training community as to the current capabilities of M&S systems, how simulations are being used to train to tasks conditions and standards addressed in T&R Manuals, as well as sharing training scenarios databases and facilitation notes.

Integrating processes and reducing "Stovepipes"

Three interrelated processes are executed to build new capabilities: Capabilities Development; Acquisition Planning; and Planning, Programming, Budgeting, and Execution (PPBE). These processes are more clearly defined in MCO 3500.19A and amplifying information may be obtained on the TechDiv web site.

Capabilities Development and Acquisition Planning can be supported through Science and Technology (S&T) development efforts at ONR. The existing Training Technology Consortium consisting of representation from TechDiv, PM TRASYS, ONR, and MCWL, is chartered to continue to provide collaboration and oversight to ensure S&T efforts address identified gaps.

The Training Technology Consortium will ensure each development process remains focused upon validated needs of the operating forces, DoD mandates, and recognized technology gaps. This process will ensure best value to the government by providing valuable input to the development of potential technology solutions. This process will also consider technologies associated with other acquisition programs, S&T development, and developing systems & technologies that can be readily integrated into existing programs.

A Comprehensive and Building Block Approach

Training simulation technologies offer an unparalleled opportunity to build toward and sustain levels of proficiency while achieving economies. Such economies include more efficient use of available time, improved utilization of ranges and training areas, reducing costly logistical training support requirements and extending the service life of combat systems by reducing wear and tear. Training simulation technology cannot be viewed as a wholesale replacement of live training. To be most effective, these technologies should be incorporated as increasing efficiency to selected training events as part of a larger comprehensive training plan that incorporates a building block approach to attaining and maintaining training and combat readiness. Using a "Crawl-Walk-Run" methodology as depicted in Figure 2, virtual and constructive training simulation technologies can be systematically applied along the training continuum.

Figure 2. The building block approach to supporting training through M&S

At the most basic level, the "Crawl" stage, virtual task trainers and minor training devices can be incorporated in a classroom environment to satisfy selected T&R tasks that build individual task proficiency or sustain basic MOS qualification. As Marines progress along the training continuum to the "Walk" stage, virtual and constructive battlefield simulations can be incorporated to develop basic collective proficiency in tactics, techniques and procedures such as patrolling or convoy operations, or at the staff level to exercise planning and execution in the context of a planned scenario and a Tactical Exercise Without Troops. Finally, in the "Run" stage, training tasks accomplished through a progression of basic familiarization and virtual training can be exercised in a live training environment; in a networked, distributive virtual or constructive training environment; or a combination of two or more. The "Run" stage can both increase the level of complexity of training by incorporating multiple related training

requirements as part of a complex training environment, and likewise serve as the means to certify a level of qualification along the training progression.

The manner in which training technologies are incorporated in this methodology can be tailored based on the priorities of the commander and the resources at their disposal. Training requirements however, remains as defined by individual and collective training standards that satisfy a Mission Essential Task List (METL).

Fielding or Distributing Critical Training Capabilities

In the near-term phase the focus is establishing management processes and oversight, validating requirements, and defining a baseline. However, the distribution and fielding of developmental and existing systems (and the acquisition of additional systems) to meet the immediate critical needs of the operating forces is time-critical due to global commitments and ongoing combat operations. Further compounding the challenge are systems that are critical to pre-deployment training and readiness to fight the Global War on Terror such as the HMMWV Egress Assistance Trainer (HEAT), MTVR-Operator Driving System (MTVR-ODS), and Virtual Combat Convoy Trainer-Marine (VCCT-M) which are currently fielded to limited locations within the active and reserve components, or are available only at the MAGTF Training Center in Twenty-nine Palms, CA.

The ability to network USMC simulations is a critical task for the near term. The connection and integration must be done utilizing the emerging Joint Training and Experimentation Network (JTEN). The purpose of this paper is to inform and increase awareness of the Joint Training and Experimentation Network (JTEN), its origin and purpose, current status, use to date, challenges, and way ahead. The JTEN is a communications infrastructure that is a high-bandwidth network linking 30 CONUS and 2 OCONUS persistent training sites along with additional capability for linking 7 non-persistent sites to meet temporary requirements. JTEN achieved Interim Operational Capability (IOC) in FY04. The Marine Corps has 4 persistent connections at 29 Palms, Yuma, Quantico and Lejuene. Figure 3 depicts connectivity that will support near term training requirements.
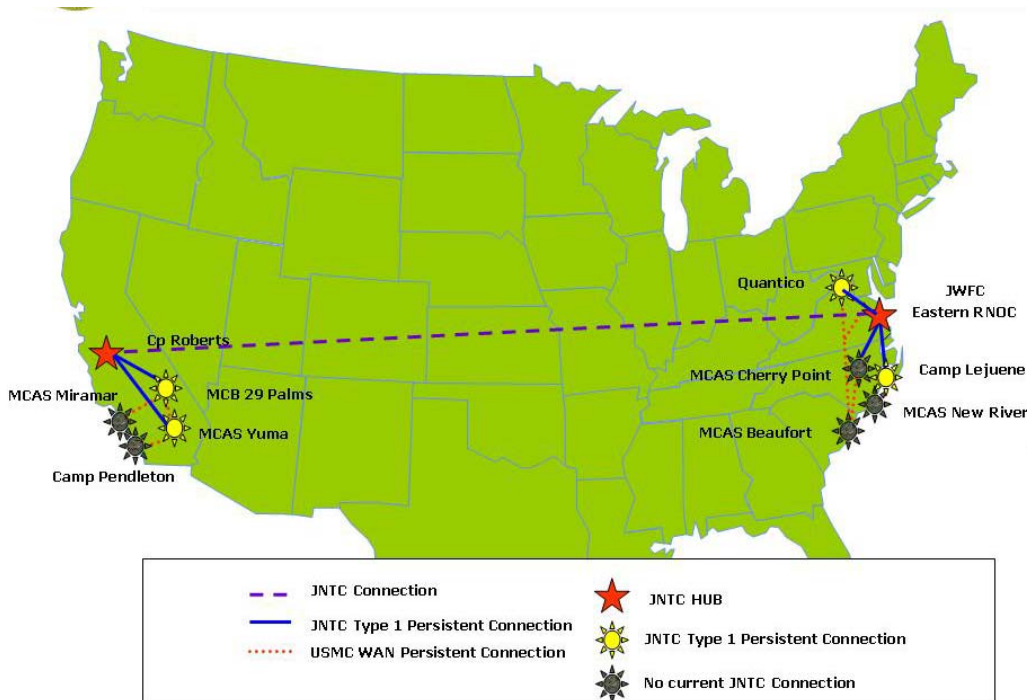

Figure 3. CONUS critical connectivity for networked training simulation

The critical needs of deployed operating forces are paramount. However, if Marines are going to "train as we fight," fielding, distribution, infrastructure requirements and manpower requirements must also be considered for the formal training centers and schools. To effectively support and institutionalize the "Crawl-Walk-Run" approach, entry level MOS training and skills progression curricula must be supported by training devices that emulate or simulate the equipment and systems Marines will employ in the operational environment. Furthermore, to maximize the return on the investment of time that Marines spend in formal training, the same training simulation technologies available to the operating forces must be available to the schoolhouse. Providing schools with the same technologies not only ensures that we are providing Commanders a Marine who is trained to a standard defined in the appropriate T&R manual, but will also enable Marines to develop skills and sustain training in the operating forces before attending formal skills progression training. The net result is a Marine who is better trained through a continuity of training resources, thereby reducing time requirements to train in both the operating forces and at the schoolhouse.

Developing Supporting Plans and Sustaining Present Investments

With validated requirements and a baseline established, supporting plans and recommendations for detailed execution of this strategy in the mid- and far-terms must be developed. Capability gaps determined through the review of training standards and available technologies should be proposed for research and development via the Training Technology Consortium. A review of the staffing of various organizations involved in training technology support needs to be conducted (i.e., Technology Division, MSTP Battle Staff Training Facility (BSTF) and the MEF level simulation centers). Furthermore, plans to educate the Total Force as to the capabilities, application and benefits of training simulation technologies as part of comprehensive unit training programs must also be established to acculturate the force and gain wide spread acceptance of M&S into the mainstream of training and operations.

Manning the Total Force for Distributive, Interactive Training

The accomplishment of objectives outlined within this strategy will require additional staffing and manning with qualified Marines, civilians and contractor personnel at key organizations both within the supporting establishment and the operating forces. Given the breadth of applicability of M&S across the spectrum of expeditionary force development, sufficient representation must be available to provide subject matter expertise to DoD level working groups, develop necessary capabilities documentation and participate fully in all phases of the Expeditionary Force Development System as the training capabilities developer. There must likewise be subject matter expertise available for collaboration in the development and acquisition of training technology. A Total Force structure review must be undertaken to ensure that requisite manpower and expertise are available to training technology locations in both the development of simulation supported training events and the facilitation of the training events across the Marine Corps.

Experience in the field of M&S can be gained through attending graduate level schools, attending shorter introduction courses, or past billets that involved M&S. The Modeling, Virtual Environment and Simulation (MOVES) Institute at the Naval Postgraduate School in Monterey, California is an internationally renowned center of excellence in modeling and simulation, and the Masters curriculum produces selectively trained and educated Marine Officers with an excellent background. MOVES graduates provide the Marine Corps with a unique resource of tactically and operationally relevant technical expertise in areas which include combat modeling systems, training systems, virtual environments, augmented reality, web technologies, networks and interoperability, human-computer interaction and human factors, and education and distance learning. There are also a number of week long to six week courses in M&S provided around the country that combined with on the job training can quickly bring a novice Marine in M&S up to speed in a billet requiring M&S Skills. Finally, a Marine's experience in a billet that involves extensive utilization of M&S would make them a key candidate for follow on billets requiring M&S experience.

Managing Training Progression

The comprehensive review of individual and collective training standards accomplished in the near term must be expanded to all ground occupational fields to identify those training requirements or opportunities

that can be most appropriately satisfied by simulation. Once that is accomplished, the next step is to identify where existing training simulation technologies can be most effectively applied to entry level and skills progression curricula and managed on-the-job training programs. The prioritized analysis and review plan resulting from detailed planning conducted in the near-term phase of this plan will guide efforts in the mid-term to identify all requirements and opportunities for the application of training simulation technology as part of MOS training progression, and to continue to update and/or revise the baseline upon which the objective systems are continually developed.

The capability to have an automated training information management system that interfaces with training simulation technologies should be developed in order to support training progression and capture the completion and results of virtual training and attendant qualifications, certifications and designations. Such a system would enable leaders and trainers to be able to access a career-length record of training for a Marine, to include not only the task and the date of completion, but also the detailed data/information reflecting the results of training. This electronic record of training, qualifications and readiness could also serve to record operational experience (e.g., combat patrols, convoys, tactical engagements, etc.) and enable a truly flexible and adaptable force by assisting leaders at all levels in recognizing those skills, knowledge, abilities, proficiency, experience and aptitudes which may ideally suit a Marine for a particular task or mission.

Continued Refinement and Resource Management

The mid-term phase is the longest of the three phases of this strategy and expands upon the baseline requirements identified in the near term to field and institutionalize the bulk of technologies that will enable and sustain the objective capability. Critical to this phase is the continued management of the objective capabilities refined and sustained throughout all phases of the EFDS.

Investments must continue to improve interconnectivity between simulation centers, bases, and stations to enable conduct of distributed training supported by the LVC-TE that is fully compliant with JNTC requirements. TechDiv will develop the necessary integrated capabilities to achieve this training via the LVC-TE Initial Capabilities Document (ICD), which is a targeted POM-2010 initiative.

The objective capability seeks to increase the availability and interoperability of virtual and constructive training throughput needs of the 21st Century Marine Corps. The broad fielding and continued improvement of training suites and the development of additional applications that are tailored to the unique training requirements of various occupational fields will increase technology supported training. Training suites at the battalions and school houses will support the simulation center's focus on regimental, division, MAGTF, Joint and Coalition level staff training requirements or those constructive aggregate force level simulations necessary for participation in Joint and combined level simulations. Figure 4 depicts interconnectivity between systems resident at bases, stations and as virtual training systems and capabilities, which enable the LVC-TE to continue towards reaching operational capability during the mid-term.
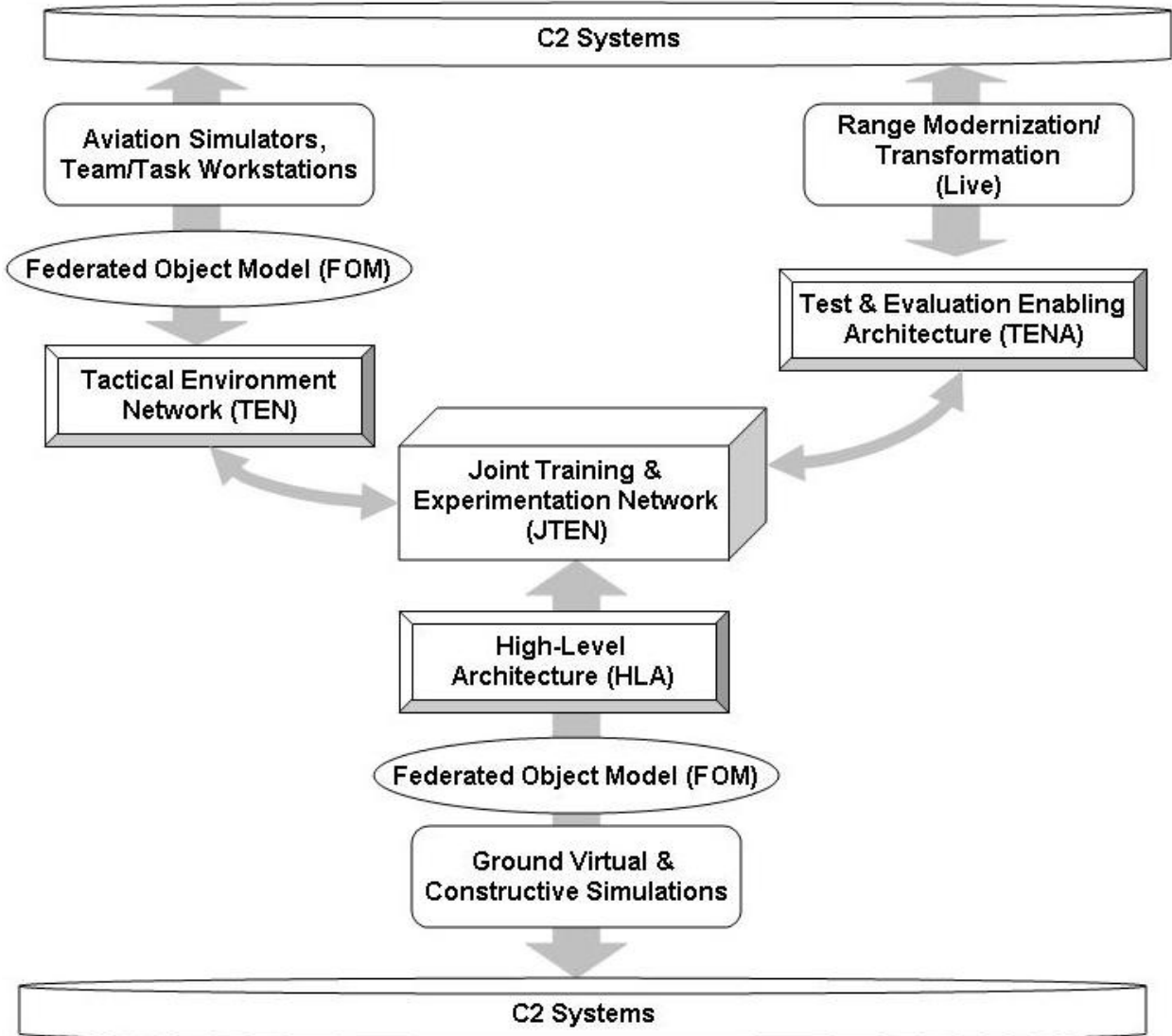
Figure 4. Interconnectivity for LVC-TE

To reduce resource demands and cost requirements; to improve the availability of training both ashore, afloat and in-transit; to achieve a scalable and deployable virtual training capability, and to minimize overhead, embedded or on-board simulations must be a mandate wherever technically feasible. Marines must come to expect this capability in their equipment to conduct training at both the individual and collective level. C2 systems that Marines use in training must be capable of emulating, simulating, or stimulating equipment functioning on the battlefield by simulating operations either as a stand alone capability or as a component of a larger C2 system. They must also be capable of receiving inputs and stimulating a broader virtual training network or environment composed of multiple applications, nodes and virtual training environments.

Continued integration of existing and emerging training simulation technologies for ground training with advanced warfighting experiments will remain a key component to ensure that the objective capability evolves and remains relevant to emerging operational concepts during this phase.

As the longest of the three phases of this plan, the mid-term phase will expand this to the next tier of critical needs that support a "Crawl-Walk-Run" methodology. An institutionalized concept for fully

integrated training that moves seamlessly between live, virtual and constructive training supported by training devices and simulation, both at home station and while deployed, is to be completed in the far-term phase. Throughout each phase however, all future systems in development or under consideration MUST include the capability to operate in a distributed and networked environment and support training capability while deployed ashore, afloat, or in transit. All future combat and combat support systems should include embedded and interoperable training and simulation capability with the basic system as a key performance parameter in the development of requirements and the management of acquisition.

Acculturating the Total Force

Educating the Total Force as to the capabilities, application, and benefits of training simulation technologies as part of comprehensive unit training programs is a continuous process in the execution of this plan. To gain acceptance of M&S in the mainstream of training and operations, Marines must understand the philosophical underpinnings for the use of training simulation technologies; they must learn about the capabilities at their disposal, and they must be familiar with how those technologies are applied within a training progression model as part of a managed training plan.

Training management and evaluation is all too often learned only through experience, with the attendant risk of some negative training occurring. For the Marine Corps to fully realize the training efficiencies and economies that these technologies offer, the capabilities and benefits of existing and emerging training simulation technology must be imparted in a coordinated and deliberate fashion "Crawl-Walk-Run" approach to training supported by live, virtual and constructive simulation.

Education and acculturation begins with exposure to and use of these systems in the schoolhouse during basic courses and skills progression training administered as formal curricula. This initial exposure is to be reinforced through use in the operating forces, and continue through professional military education that occurs at all levels, to include the NCO and SNCO courses as well as career and intermediate level schools for the officer corps. Education should be reinforced through an information campaign executed by TECOM, consisting of developing and distributing marketing materials, and sponsoring various "road shows" conducted for the operating forces with the objectives of highlighting capabilities, receiving feedback, answering questions, and deconstructing persistent cultural barriers.

Achieving and Sustaining the Objective Capability

The far-term phase provides for fielding of final operational capabilities to realize the objective end state, and puts in place a fully institutionalized concept for integrated training that moves seamlessly between live, virtual and constructive environments enabled by training devices and simulation that provide progressive training capability. This capability is represented in fully developed and prolific training simulation technologies accessible by both the active and reserve components. These applications will provide a mission planning and rehearsal capability in both the training and operational environments, and will be fully deployable and functional systems accessible down to the small unit level.

Management policy, organizations and processes established and refined in the near- and mid-terms sustain the transformation to the 2017 planning horizon and beyond through the development and refinement of detailed supporting plans consistent with established Marine Corps and Joint processes for capabilities development. POM, PR, and supplemental appropriations are updated on cycle to sustain present investments and to fund desired future capabilities. Figure 5 depicts the objective capability for a fully networked architecture that supports distributed, interactive training simulation technologies.
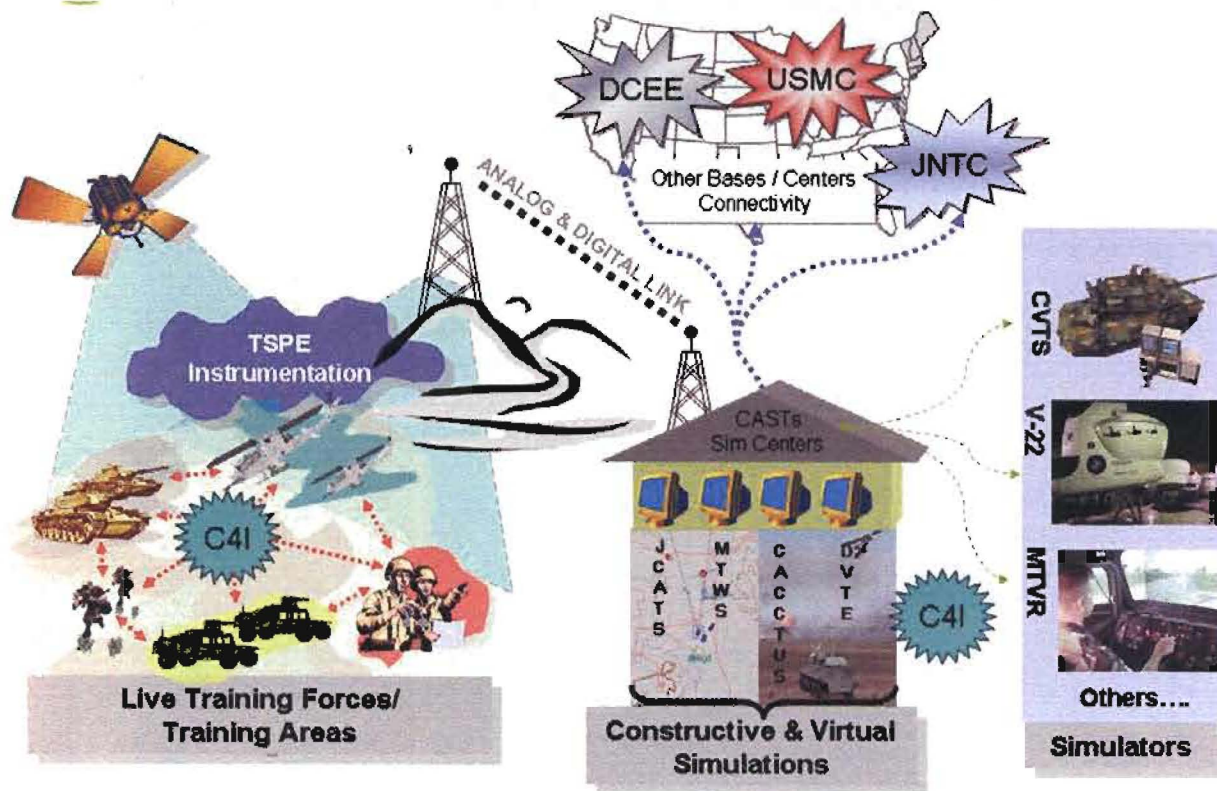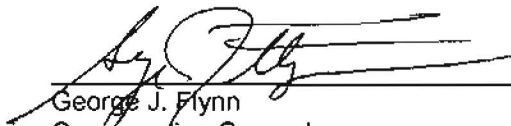
Figure 5. Objective Full Operational Capability for integrated LVC training simulation

Gaps in reaching the Objective Capability

To assist the S&T community to understand the S&T needs as viewed from the standpoint of those who determine training requirements for the Marine Corps, a Training S&T "Long Poles in the Tent" Paper is created on a regular basis. These are all long poles in the tent, things that must be done in order to allow Marines to best exploit training technology. Until these needs are met, Technology-Supported Training will not be used consistently or effectively or at the needed capability level in support of either training or mission rehearsal. S&T Long Poles Paper is provided in Attachment C.

George J. Flynn
Commanding General
Training and Education Command

Appendix A

Plan of Action and Milestones (POA&M)

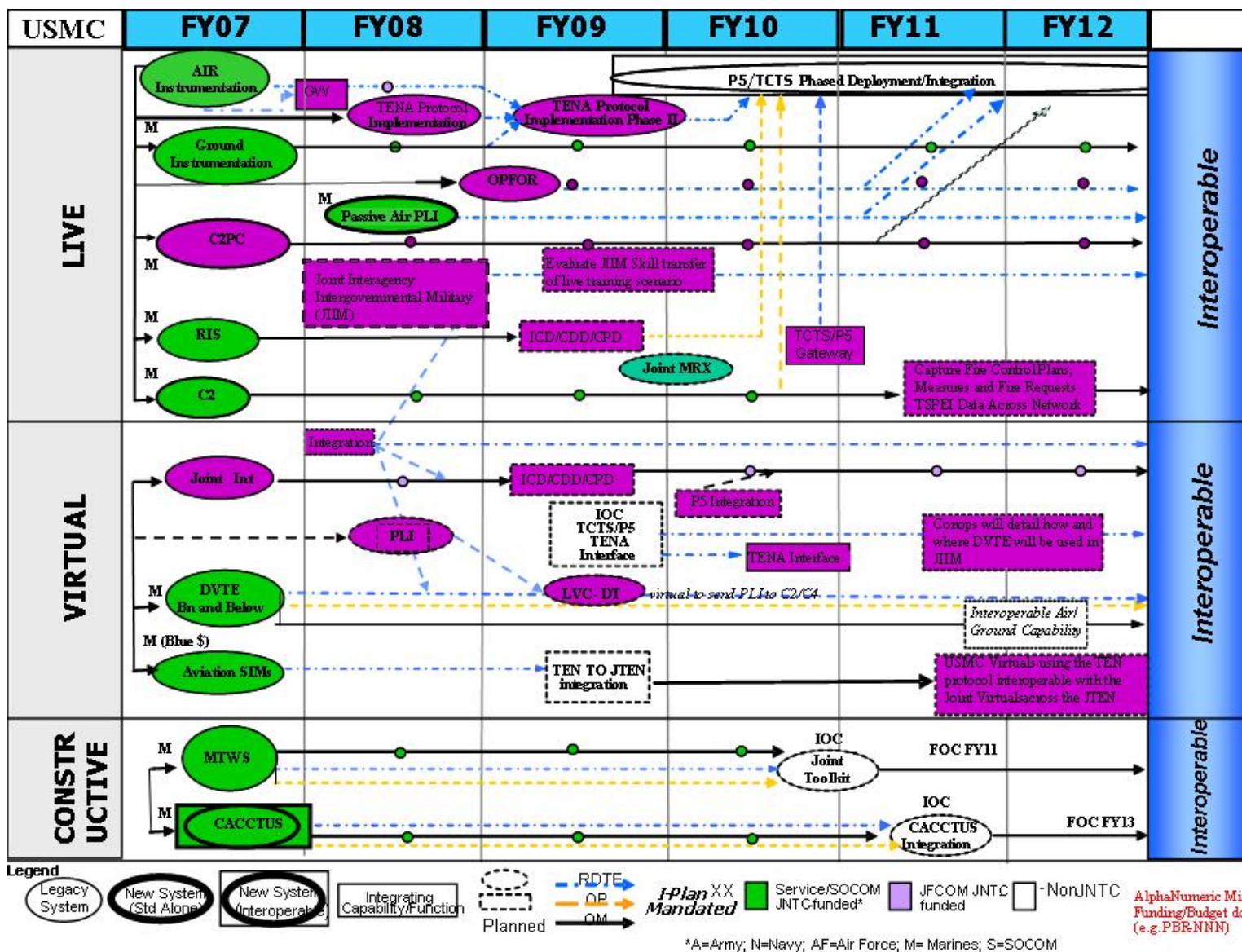| | | **Training M Master Plan** | | | | | | | | | | | | | |
| | | POA&M | | | | | | | | | | | | | |
ID	Task Name	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
1	**Near-Term**														
2	Establish M&S Working Integrated Product Team (WIPT)														
3	Implement EFDS functions for M&S Capabilities Development														
4	Review combat training standards for simulation applicability														
5	Acquire and field current planned training simulation technologies														
6	Validate requirements and identify technology gaps														
7	Submit Program Change Proposals for current programs														
8	Develop detailed supporting implementation plans														
9	Develop Staffing plans														
10	Develop five-year experimentation plan														
11	Prioritize training requirements by OccFld														
12	Submit POM-10 initiatives					POM-10 Initiatives									
13	Develop divestiture plan for legacy systems														
14	**Mid-Term**														
15	M&S Support Force Structure Review and Manning														
16	Achieve Full LVC-TE/JNTC Capabilities														
17	Submit POM 12 initiatives				POM-12 Initiatives										
18	Review support training standards for simulation applicability														
19	Submit POM-14 initiatives						POM-14 Initiatives								
20	**Far-Term**														
21	Submit POM-16 initiatives								POM-16 Initiatives						
22	Regular Marine Training in the LVC-TE and JNTC														
23	Full Virtual Mission Rehearsal Capability														
24	**Continous Efforts**														
25	Sustain present investments														
26	Sustain and expand requirements and capabilities														
27	Identify emerging training simulation technology														
28	Identify and prioritize systems for integration with M&S														
29	Prioritize and resource ongoing and future initiatives for R&D														
30	Experimentation for simulation technology to emerging concepts														
31	Execute a Training simulation technology road show														
32	Monitor execution of supporting plans														

Page 1

A-1

Appendix B

LVC Interoperability Roadmap
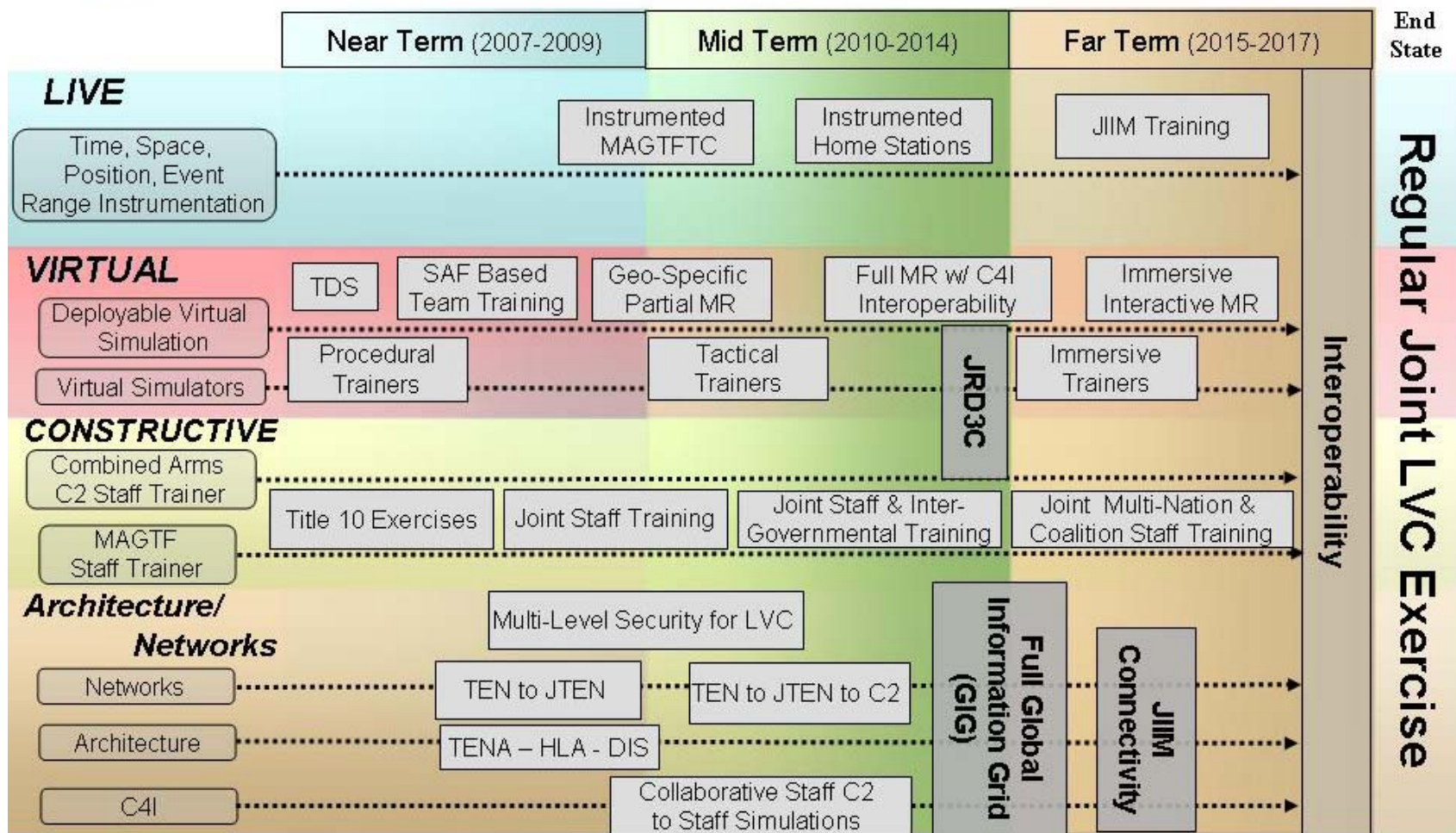
LVC Simulation Roadmap

Appendix C

Training Science & Technology Long Poles in the Tent
Marine Corps perspective on S&T shortcomings
relative to training technology

As the Marine Corps strives to effectively and efficiently train Marines in the future through the appropriate application of training technology, there are some areas that are believed to be Science and Technology Long Poles. These are areas that, if solved, could provide advanced capabilities for training technology and methodologies to exploit the technology for training Marines.

The Marine Corps will exploit the Live, Virtual, and Constructive Training Environment (LVC TE) to provide lower-cost opportunities to train more robustly. This environment will also be used for Mission Planning and Mission Rehearsal in the future. This environment must have critical functionalities or environmental realities so as not to provide negative training.

The following list revolves around those factors that either directly affects realistic training or that facilitate realism in training. These are all long poles in the tent, things that must be done in order to allow Marines to "Train Like We Fight" in a technology supported training environment.

Mission Planning and Rehearsal Terrain

- To support Mission Planning and Rehearsal, the ability to have access sub-meter resolution terrain environment databases for any specified area and to use that 3D terrain model aboard the ships of an Amphibious Readiness Group (ARG) or other dispersed areas Marines would conduct Mission Planning and Rehearsal within 72 hours of location selection by a COCOM must exist for use in the LVC-TE.

Targets for the LVC TE. In a LVC-TE targets must be represented across different LVC training audiences. An example of this would be a virtual enemy tank platoon being seen by a live forward air controller and engaging aircraft.

- Targets in the LVC-TE must be seen by live, virtual and constructive training audiences, with appropriate degradation due to weather and the correct signatures for optics.

- They can be engaged by live, virtual or constructive forces with ordnance and munitions with realistic results seen by all.

- Targets must move as ground (wheeled and tracked) and aviation (fixed wing and rotary wing) vehicles.

- Targets must be controlled by the trainer, must leave little to no physical residual effects on live ranges and training areas.

- Target occupants with the ability to represent appropriate human behaviors (exit vehicle and return fire, exit vehicle and surrender, exit vehicle and flee).

- Targets with a shoot back capability that produces physical stimulus (electric shock, blurred vision, audio incapacitation) to live training audience or damage to virtual and constructive forces.

Virtual Urban Structures and Objects for the LVC-TE.

- Urban structures and objects must be visible by live, virtual, and constructive training audiences.

- Can be created quickly, and tailored to represent any geo-specific location.

- Buildings, vehicles and objects must be capable of being breached, entered or moved to permitting cognitive skills to be exercised.

- Urban structures must be able to have variable physical properties (thickness, gauge of metal, material composition, size, etc.) and realistic damaging characteristics when engaged with weapon systems or breaching methods.

Human Representation and Interaction with the LVC TE.

- Live forces must be trackable indoors and out for representation in the LVC-TE. Position Location Information (PLI) tracking for individuals is needed that is not restricted by line of sight (LOS) and is transportable/ deployable.

- The LVC-TE must have the ability to have Human Anatomy Motion-Tracking and Display (HAM-TD). This is the capability to map and display movements of the human body in order to capture or display the actions of live, virtual and constructive training audiences in an immersive training environment. An example would be hand signals from an adjacent virtual fire team or high resolution interaction with virtual human players.

- Human models must exhibit appropriate cultural, emotional, religious and ethnic responses (to include voice interaction with both virtual characters and live participants) to stimulus imposed by the training environment including Mission, Enemy, Terrain & Weather, Time, Troops Available and Civilian (METT-TC) and the training audience.

Accelerated Learning Science (ALS)

- The constant push to master more material in less time requires the development of strategies and systems that can accelerate learning. Rapid training, in turn, also requires methods for providing the Marine with the tools to quickly process information and solve problems. The need, therefore, is for cutting edge instructional systems that can <u>rapidly</u> prepare Marines for deployment. Specific S&T gaps include:
    - Foundations of learning applied to complex tasks. Cognitive Load Theory and Instructional Efficiency must be extended to complex task learning.
    - Training interventions triggered by neurophysiological markers of learning and cognition.
    - Principles of expertise development and strategies tailored to continual proficiency models, beyond today's simplified novice or expert techniques.

- One method to achieve this is perpetually changing scenarios to support full Range of Military Operations (ROMO) in all cultural and geographic areas. Artificially Intelligent (AI) Opposing Forces (OPFOR) in scenarios should learn from participant's actions and change tactics based on these patterns. Embedded Mentor or AI Drill Instructor (AI DI): An intelligent tutoring system that not only scores the user based on given Marine Corps training standards but is also able to diagnose the cause of the problem and offer help to correct the deficiency; show portion of appropriate publication, or a PowerPoint slide. AI will be able to gauge user's proficiency and adjust the scenario (up or down) as appropriate to meet the user's training needs.

Experiential Learning Technologies

- Marines need to "train like they fight" and be prepared for fluctuating mission circumstances. While RCAX (Revised Combined Arms Exercise) is an effective tool for unit training, it is too resource intensive to be conducted often enough to maintain optimum readiness. Technologies are needed to give units RCAX-like training at their home station or while deployed. Rather than operating exercises on computers, Marines need to be physically engaged in the training, combining both the cognitive and the physical elements into a single seamless system.

- Current training and education solutions, however, are developed for the "standard" student Marine in ideal conditions; programs therefore require substantial dedicated time to complete, and success rates are not ideal. This uniform approach does not allow for adaptation of training solutions across employment situations (i.e. schoolhouse, in garrison pre-, during- or after-deployment and/or on-the-job/embedded) to the students' or team's needs, learning styles, current proficiency or expertise levels. The result is often inefficient and ineffective training.
    - Need for course content and delivery architecture.
    - Need for Adaptive Instructional Delivery Architecture and foundation science for optimized implementation strategies.
    - Strategies for dynamic, tailored learning in both live and virtual training environments.
    - Experimentation platforms focused on required hooks/tools i.e. reconfigurable tasks, automated performance measurement and multi-modal, adaptive mitigations i.e. cuing and feedback.

Non-kinetic Effects Simulation
- The injections of PMESII non-kinetic effects into operational level staffs exercise are needed to support all elements of national power, future operations and long-term assessments. This capability must not add to the number of support personnel for an event. Currently this aspect is wargamed in a seminar format combined with the kinetic effects of a simulation training exercise.

  - **Political.** Effectiveness of the government (subsequent population attitudes toward government and outside intervention/assistance. Effect on the country's population support infrastructure and economics). Others include political group modeling, effects of changes in political leadership and effects of neighboring country support/cooperation/hostility.
  - **Military.** The ability to exercise military objectives both kinetic and non-kinetic.
  - **Economic.** Effect of employment/unemployment (group attitudes, increased/decreased reliance on aid); Financial aid (construction of infrastructure/housing/schools and subsequent second order affects) Banking infrastructure (lending capability for items listed above), Balance of trade - general effects to national capability, Value of the dollar – general effects to national capability.
  - **Social.** Civilian population representation going about their daily routine (or not going about their routine). This would include foot traffic and vehicle traffic. Capability to monitor the reactions of population groups and dynamically adjust parameters and reactions.
  - **Infrastructure.** Infrastructure of the host or assisted nation needs to be represented within the simulation model so the actions on the infrastructure affect the civilian population groups thus creating higher order effects throughout the simulation.
  - **Informational.** Dynamically adjust attitudes and behaviors of population groups based on the effectiveness or ineffectiveness of information efforts.

These "Long Poles" are in addition to those areas highlighted in The Marine Corps Science and Technology Plan dated September 2005. The areas in the S&T Plan that apply to Training and Education include:

- HPT&E STO-1: Cognitive Performance Enhancement Methodologies and Technologies
- HPT&E STO-2: Synthetic Environment Technologies
- HPT&E STO-3: Training Technology Enhancement Tools and Technologies

Appendix D

Web Based Resources

Description	URL
Current Tasks and Milestone Status:	http://www.tecom.usmc.mil/techdiv/
Supporting Plans:	http://www.tecom.usmc.mil/techdiv/
Definitions:	http://www.tecom.usmc.mil/techdiv/
Training Capabilities Development	http://www.tecom.usmc.mil/techdiv/
Current Programs and Locations:	http://www.marcorsyscom.usmc.mil/trasys/trasysweb.nsf
TDS Resources:	http://www.marinenet.usmc.mil/portal/
Marine Corps Center For Lessons Learned (MCCLL) - Training Simulation Discussion Group	https://www.mccll.usmc.mil

Appendix E

Acronym List

Acronym	Definition
AFATDS	Advanced Field Artillery Tactical Data Systems
BSTF	Battle Simulation Training Facility
C2PC	Command and Control Personal Computer
C4I	Command, Control, Communications, Computers and Intelligence
CACCTUS	Combined Arms C2 Training Upgrade System
CAST	Combined Arms Staff Trainer
COCOM	Combatant Command
CoE	Center of Excellence
DARPA	Defense Advanced Research Projects Agency
DoD	Department of Defense
DVTE	Deployable Virtual Training Environment
EFDS	Expeditionary Forces Development System
EMW	Expeditionary Maneuver Warfare
FOM	Federated Object Model
GCE	Ground Combat Element
GIG	Global Information Grid
GWOT	Global War on Terror
HAM-TD	Human Anatomy Motion-Tracking and Display
HEAT	HMMWV Egress Assistance Trainer
HLA	High Level Architecture
ICD	Initial Capabilities Document
IOW	Intelligence Operations Workstation
JADOCS	Joint Automated Deep Operations Coordination System
JCATS	Joint Conflict and Tactical Simulation
JIIM	Joint, Interagency, Intergovernmental, and Multinational
JNTC	Joint National Training Capability
JRD3C	Joint Rapid Distributed Database Development Capability
JTEN	Joint Training and Experimentation Network
LOS	Line of Sight
LVC-TE	Live, Virtual and Constructive – Training Environment
M&S	Modeling and Simulation
MAGTF	Marine Air Ground Task Force
MAGTFTC	Marine Air Ground Task Force Training Center
MCCDC	Marine Corps Combat Development Command
MCL	MAGTF Capability List
MCTL	Marine Corps Task List
MCWL	Marine Corps Warfighting Laboratory
MEF	Marine Expeditionary Forces
METL	Mission Essential Task List
METT-TC	Mission, Enemy, Terrain & Weather, Time, Troops Available and Civilian
MOS	Military Occupational Specialty
MOVES	Modeling, Virtual Environment and Simulation
MR	Mission Rehearsal
MRL	MAGTF Requirement List
MSTP	MAGTF Staff Training Program
MTVR-ODS	MTVR – Operator Driving System
MTWS	MAGTF Tactical Warfare Simulation
NCO	Non-commissioned officer
NMCI	Navy-Marine Corps Intranet
ONR	Office of Naval Research

P&R .... Programs and Resources
PLI .... Position Location Information
PM TRASYS .... Program Manager for Training Systems
PMESII .... Political, Military, Economic, Social, Infrastructure and Information
POA&M .... Program of Actions and Milestones
PPBE .... Planning, Programming, Budgeting and Execution
ROMO .... Range of Military Operations
S & T .... Science and Technology
SNCO .... Staff Non-commissioned officer
T&R .... Training and Readiness
T2 .... Training Transformation
TBMCS .... Theater Battle Management Core Systems
TDS .... Tactical Decision-Making Simulations
TechDiv .... Technology Division
TECOM .... Training and Education Command
TENA .... Training Enabling Architecture
VBS2 .... Virtual Battlefield Simulation 2
VCCT-M .... Virtual Combat Convoy Trainer – Marine
WIPT .... Working Integrated Product Team

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